Treatment of the Persistent Sciatic Artery

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The persistent sciatic artery is a rare vascular anomaly, with only 37 reported cases in the world literature. Estimates of incidence, based on angiographic series, range from 0.04 to 0.06%. It may pose a threat to the viability of the lower extremity, for the pathologic character of the persistent sciatic artery is such that it is especially prone to atheromatous degeneration, thrombosis, distal thromboembolization, aneurysmal formation, and rupture. Although rare, the possibility of such an anomaly must be borne in mind with *certain clinical presentations*, during orthopedic procedures on the hip, and during angiographic studies of the leg. Successful surgical correction of the problem necessitates excluding the anomalous artery from the circulation while revascularizing the lower extremity.

THE PERSISTENT SCIATIC ARTERY represents a rare but potentially serious anomaly, in which the primitive vascular trunk persists as the major blood supply to the lower limb. The first published report of persistent sciatic artery appeared in *Lancet* in 1832.[6] A survey of the world literature reveals only 25 reported cases prior to 1966, all stemming from cadaveric studies.[17] In these early reports, little mention was made of clinical symptoms and signs related to this anomaly.

With the increased frequency of arteriography, additional cases have been reported.[3] Furthermore, earlier detection has permitted better correlation of clinical findings with this entity, and has invited more aggressive surgical therapy to prevent the potentially serious complications of the persistent sciatic artery. The limb itself may be in jeopardy, since the vessel is subject to early atheromatous degeneration. This frequently leads to aneurysmal dilatation, occlusive thrombosis, or thromboembolization. Symptoms of ischemia following thrombosis of the artery require only a revascularization procedure. However, the patent anomalous vessel usually needs to be interrupted proximally and distally, and a femoropopliteal bypass constructed. The management of this unusual condition is illustrated by the following two patients.

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Submitted for publication: May 30, 1983.

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Case Reports

Case 1. A 55-year-old man with a history of hypertension was admitted to the hospital with the complaint of bilateral calf claudication of several months' duration, more severe in the right leg. On physical examination, no bruits were noted and the right popliteal pulse and the pedal pulses bilaterally were absent. Doppler pressures were as follows: Average brachial pressure was 156 mmHg. Pressure in the left thigh was 152 mmHg, in the left calf 158 mmHg, and in the left ankle 142 mmHg. Pressures in the right leg were: thigh 150 mmHg, calf 142 mmHg, and ankle 122 mmHg.

Arteriography revealed occlusion of the proximal portion of a persistent sciatic artery on the right (Fig. 1A). Presumably, occlusion of the sciatic artery gave rise to his recent symptoms of claudication. The superficial femoral artery on the right was hypoplastic and became attenuated in the distal thigh. The left superficial femoral artery was complete, while the left persistent sciatic artery was hypoplastic and terminated in the distal thigh (Fig. 1B). Because of the poor distal arterial runoff exhibited on arteriogram, and since an aneurysm was not identified, no operative procedure was performed.

Case 2. A 60-year-old woman was hospitalized after experiencing the sudden onset of right leg and hip pain, without foot or calf claudication. There was no history of recent trauma nor of pain at rest. Physical examination of the vascular system was normal. However, the course of an anomalous vessel, as well as areas of increased turbulence, could be traced over each hip and lateral thigh by Doppler ultrasound.

Noninvasive vascular studies demonstrated normal segmental pressures in both the right and left leg. Arteriography revealed bilateral complete persistent sciatic arteries and aneurysms in the upper thighs. Both superficial femoral arteries were hypoplastic and terminated in the distal thighs (Fig. 2). The patient's symptoms were thought to be due to expansion and possibly embolism from the right sciatic artery aneurysm. Therefore, first the right and then the left persistent sciatic arteries were ligated at the level of the sciatic foramen and divided at its junction with the popliteal artery. Saphenous vein bypass grafts were placed from the common femoral artery end-to-end to the laterally displaced popliteal artery.

Discussion

Although estimates of the incidence of persistent sciatic artery are rough at best, there is no doubt that it is an extremely rare vascular anomaly. Based on angiographic series,[4,5,10,11] its incidence is approximately 0.05%. Almost half of the reported cases have been bilateral, and there seems to be no gender preference. Ages of afflicted persons

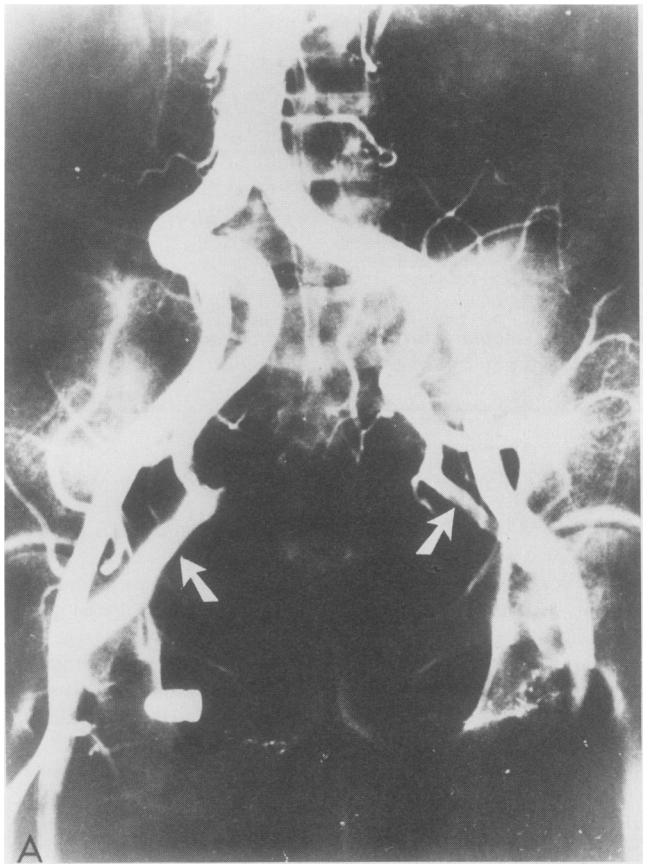

FIG. 1. Case 1. (A.) Aortogram with proximal runoff, demonstrating bilateral persistent sciatic arteries.

range from 15 to 85 years, but the mean age is 45. The incidence of aneurysm formation approaches 15%.

In the majority of cases, the sciatic artery has been complete; that is, there is no significant diminution in caliber as it courses from the internal iliac to the popliteal artery. The sciatic artery has been incomplete in only three reported cases. This is an angiographic finding and implies that its course is discontinuous, or connected to either the internal iliac or popliteal arteries by only small collaterals. The first patient in this report represents the first reported case of a complete sciatic artery on one side and an incomplete one in the other limb.

Associated hemihypertrophy of the pelvis or leg,[18] and a short leg[4] have been reported. The more common physical finding is a pulsatile mass in the buttock, representing aneurysmal dilatation of the atavistic artery.

Embryology

In the growing human embryo, the mesenchymal blood islands form clefts which gradually develop into isolated vascular spaces. Within these vascular spaces, capillary plexuses differentiate. By 4 weeks, when the embryo is 5 mm in length and comprised of the full 42 somites, the capillary plexuses have coalesced into the major vascular trunks of the body (Fig. 3). Definitive blood vessels arise as a function of neighboring organ development, inherent patterns of differentiation (the so called vascular organizers), and regional differences in blood flow. When flow becomes decreased or diverted, primitive vessels undergo atrophy.

To form the extremities, a limb bud develops from the trunk and acquires a capillary plexus as it enlarges. By consolidation within the plexus, an axial vessel arises, eventually achieving continuity with the umbilical artery. By the 9-mm stage, this sciatic or ischiatic artery, is the chief arterial stem, terminating in a single capillary plexus nourishing the primitive foot (Fig. 4). Subsequently, the femoral artery, as a continuation of the external iliac, begins to supersede the axial artery by annexing the sciatic and its branches distal to the middle thigh.

Normally, the sciatic artery undergoes atrophy in the distal thigh, and, by the 22-mm stage, its continuity has been interrupted in the region of the gluteal fold. The

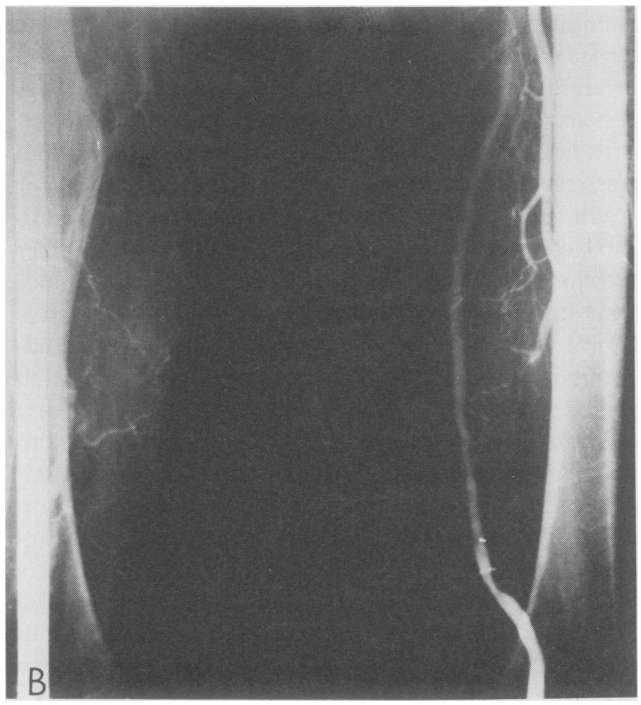

FIG. 1. Case 1. (B.) Proximal runoff showing an incomplete femoral system on the right, consistent with a complete right sciatic artery. The left femoral system is fully developed, with a vestigial (incomplete) sciatic artery. (Several years earlier, an intramedullary rod had been placed for a femoral fracture from a gunshot wound.)

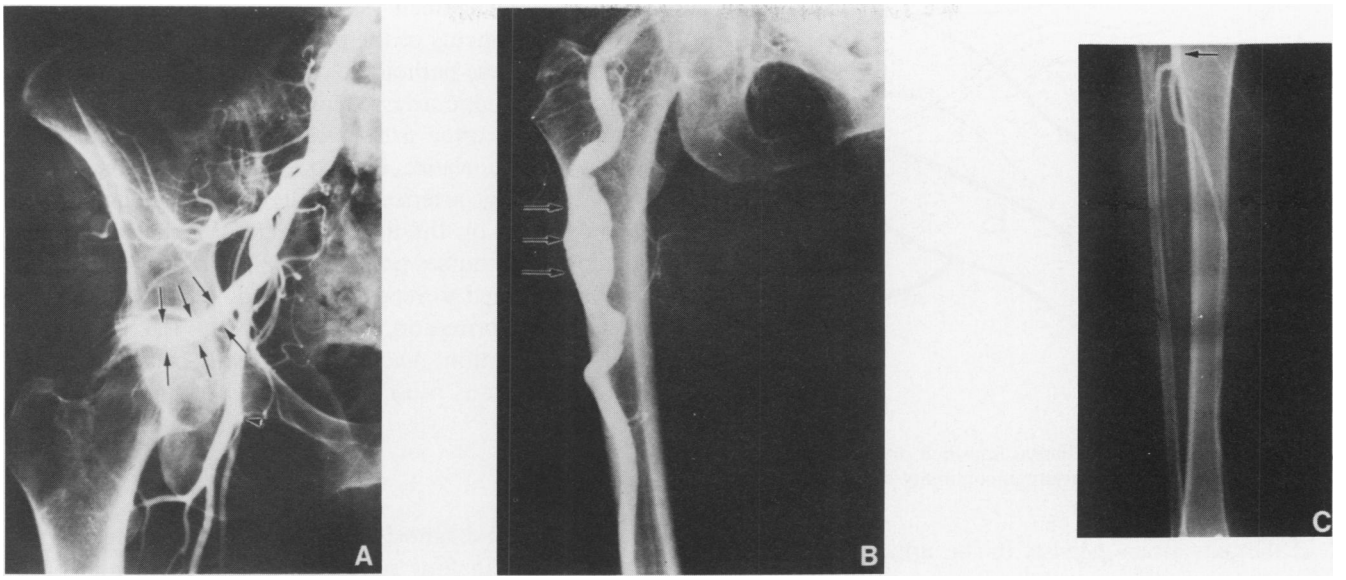

FIG. 2. Case 2. (A.) Selective right common iliac arteriogram in Case 2. Arrows indicate sciatic artery arising from a large internal iliac artery. (B.) Aneurysm of sciatic artery in upper thigh. (C.) Distal arteriogram demonstrating junction of sciatic artery with a normal popliteal system (arrow). (The abnormality in the left leg was identical to the right.)

union of the superior ramus communicans with the ischiatic artery heralds the termination of the latter's major role in vascularizing the leg. With full development of the femoral system, remnants of the sciatic artery persist as the proximal portions of the inferior and superior gluteal arteries and as the popliteal, anterior tibial, and digital vessels (Fig. 5A).

When this process is frustrated, it is the superficial femoral system which is atretic in the distal thigh, usually terminating at the adductor hiatus, while it persists in the leg as the posterior tibial artery (Fig. 5B). Occasionally, the femoral artery is quite short and ends as a common profundo-circumflex trunk.

Anatomy

The sciatic artery, as a continuation of a hyperplastic internal iliac artery, gives off the superior gluteal and internal pudendal arteries within the pelvis. The anomalous vessel then enters the thigh through the lower portion of the greater sciatic foramen, below the pyriformis muscle. At the foramen, it gives off an inferior gluteal branch.[2] Exiting the foramen, the sciatic artery bears a variable relationship to the sciatic nerve and to the nerves of the posterior thigh, occasionally lying within the nerve sheath.[12]

The course of the sciatic artery carries it deep to the gluteus maximus and hamstring muscles of the thigh. It proceeds along the posterior surface of the adductor magnus muscle, usually receiving perforating vessels from the profunda femoris artery, and then passes lateral to the insertion of the adductor magnus to enter the popliteal fossa in continuity with the popliteal artery.[12] The accompanying veins may themselves be dilated and in close proximity to the sciatic artery and nerve, thus posing an additional hazard during dissection in the area.

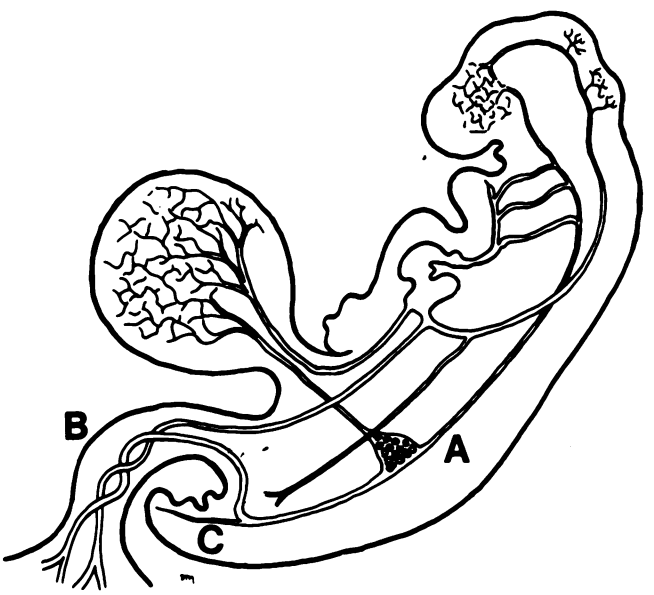

FIG. 3. Case 3. Four-week embryo, depicting major vascular trunks. (A.) Aorta. (B.) Umbilical stalk and vessels. (C.) Axial or sciatic artery.

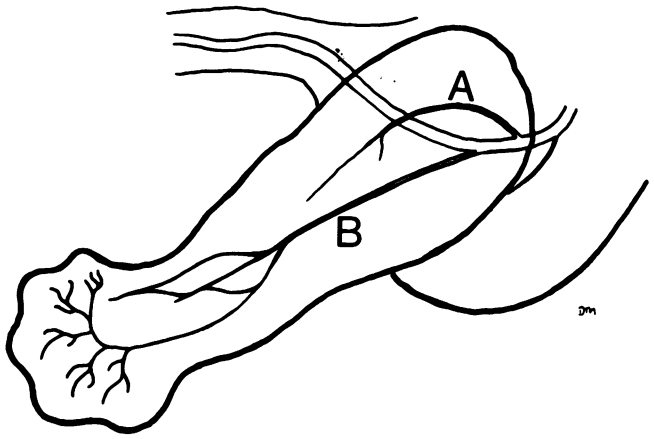

FIG. 4. Case 4. Nine-week embryo limb bud. (A.) External iliac and femoral system. (B.) Sciatic artery in continuity with popliteal system.

If the axis artery persists in the upper extremity, the proximal part of the primitive artery is normally retained in the arm as the axillo-brachial complex, where it is protected in the flexor areas of the arm. The anomaly thus consists of medial and interrosseous arteries persisting as the main channels into the hand, with hypoplastic ulnar and radial arteries.[1]

Pathology

Unlike the fully developed femoral system, the persistent sciatic arterial wall is prone to early atheromatous degeneration and aneurysm formation. Hypoplasia of the elastic components of the primitive arterial wall may be a factor in these pathologic changes.[11] Histologic studies of resected sciatic artery demonstrate severe atherosclerotic changes, often with calcification, with or without a deficit in the elastic components of the vessel wall. Whereas major arteries normally follow a course in the fascial planes on the flexor aspects of articulations, the sciatic artery courses posteriorly in the buttock and thigh and is subjected to repeated trauma. This may result in aneurysmal formation, rupture, thrombosis, and atheroma embolization. Aneurysms typically occur under the gluteus maximus muscle at the level of the greater trochanter.

Diagnosis

The clinical diagnosis of persistent sciatic artery is unlikely except in four situations: (1) its incidental demonstration during arteriography; (2) the presence of a pulsatile gluteal mass; (3) neurological symptoms resulting from sciatic compression by a dilated aneurysm; and (4) the extremely rare case in which both the external iliac and femoral arteries are occluded in the presence of a patent sciatic artery, thus giving rise to the unusual clinical finding of absent femoral pulse with palpable popliteal and/or pedal pulses.[3] One must be careful to exclude a history of recent trauma that may have resulted in a false aneurysm. The case reported by Smyth as a gluteal aneu-

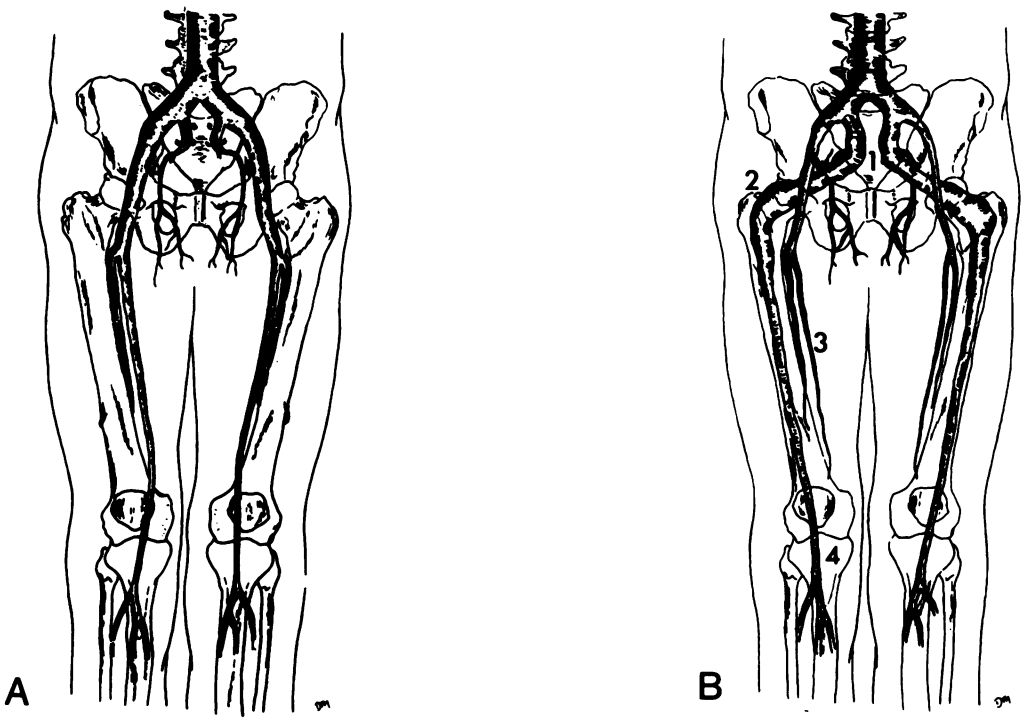

FIG. 5. Case 5. (A.) Normal arterial system of lower extremities. (B.) Bilateral persistent sciatic artery: (1.) enlarged internal iliac artery giving rise to the sciatic artery which passes out of the pelvis via the greater sciatic foramen; (2.) aneurysm of sciatic artery; (3.) attenuated femoral system; and (4.) continuity of sciatic artery with normal popliteal system.

TABLE 1. *Operative Treatment of Persistent Sciatic Artery*

Author, Data	Clinical Data		Anatomy			Operation
	Age	Sex	Side	Aneurysm	Sciatic Artery	
Hutchinson, 1968[7]	63	F	Left	Yes	Complete	Exclusion of aneurysm, Dacron bypass
Steele, 1976[14]	65	F	Right	Yes	Complete	Aneurysmorrhaphy and saphenous vein interposition graft
Lindenbaum, 1977[9]	65	F	Right	Yes	Complete	Saphenous vein graft bypass of aneursym
Bower, 1977[2]	60	F	Right	No	Complete	Right lumbar sympathectomy
Thomas, 1978[15]	53	M	Bilateral	Yes	Complete	Ligation of sciatic artery proximal to aneurysm
Tisnado, 1979[16]	42	F	Right	Yes	Complete	Exclusion of aneurysm, femoropopliteal saphenous vein bypass graft
Vimla, 1981[17]	45	M	Bilateral	Yes	Complete	Aneurysmorrhaphy, Dacron interposition graft
Present Case 2, 1982	60	F	Bilateral	Yes	Complete	Exclusion of sciatic artery aneurysms, femoropopliteal saphenous vein bypass grafts

rysm may have represented a traumatic aneurysm of the persistent sciatic artery.[13] As demonstrated by the cases presented here, the clinical signs and symptoms of persistent sciatic artery are determined by its complications.

Apart from autopsy studies, angiography is the most common means by which the anomaly is discovered. An aortogram demonstrating bilateral runoff is essential to visualize the internal iliac system from which the anomalous artery originates.

Doppler examination provides an excellent means of tracking the course of the vessel and locating regions of pronounced turbulence which may signify the presence of aneurysms. Other noninvasive studies such as a pulse volume recording usually are not helpful, unless there is occlusive arterial disease.

One needs to be especially aware of the possibility of a persistent sciatic artery in special circumstances. As pointed out by others,[9] this is particularly the case during hip surgery since there may be a certain overlap of symptoms. At a time when renal transplantation is being offered more frequently, it is imperative to be aware of this anomaly of the recipient internal iliac artery. Division of the artery for the transplant renal artery anastomosis would result in limb ischemia if there were a persistent sciatic artery.

Surgical Treatment

Bower, in his excellent review of the literature in 1977, reported a total of 31 cases of this anomaly.[3] Only three of these cases underwent surgery directed at alleviation of problems stemming from the persistent sciatic artery. One patient underwent unilateral lumbar sympathectomy for calf claudication. Another patient was treated by proximal ligation of the axial artery and a third by aneurysmorrhaphy with a Dacron interposition graft. Eight additional cases have been treated surgically and are summarized in Table 1. They represent a variety of surgical approaches. When the sciatic artery has been shown to be occluded, and the patient is symptomatic, a femoral to distal arterial bypass with a prosthetic graft[7] or with a reversed saphenous vein graft[9] is adequate treatment.

A patent artery with an aneurysm may be replaced with an interposition graft,[14,17] but this does not alleviate the excessive trauma to which it is subjected on the extensor surface. A preferable method is to exclude the aneurysm from its point of exit from the pelvis to its junction with the popliteal artery, and to construct a femoral to popliteal bypass to re-establish flow. This last method was used in our second case. It completely precludes further complications from the degenerative vessel by terminating flow. One also avoids placing a bypass graft in the same vulnerable position along the extensor surface of the thigh. Occasionally, when more proximal control is required, a suprainguinal extraperitoneal approach will allow isolation at its origin from the common iliac artery. The aberrant path of the persistent sciatic artery in the upper leg permits a lateral approach to the popliteal fossa. Finally, revascularization of the lower extremity performed in this fashion more faithfully reconstitutes normal vascular anatomy.

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